ELEX 7860 : Wireless System Design
2013 Winter Session

Assignment 3

1. Consider a simple cellular system consisting of a cluster of N cells surrounded by another 6 N-cell clusters.

   Write a simulation program that calculates the uplink (reverse channel) SIR distribution for cluster sizes of N=1, 3 and 7.

   For each trial, the desired user should be randomly located within one of the cells in the center cluster. The six interfering users should be randomly located within the corresponding interfering cells in the other six clusters.

   The SIR should be computed assuming equal transmit powers and an d^3 path loss law.

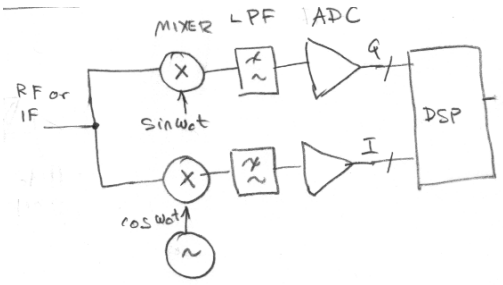
   Your simulation should compute and collect the SIRs for 1000 trials where each trial consists of one randomly-chosen desired user location and 6 randomly-chosen interferer locations. The program should then print SIR (in dB) achieved in at least 99%, 90% and 50% of the trials. It should do this for each of the above values of N.

   Handn in your code and the output of the program.

   Hints:

   - The distance between the center of a cell and the center of its co-channel cells is $\sqrt{3N}$.
   - You can generate a random point that is uniformly distributed within a non-rectangular region by generate points within a rectangular bounding box and discarding points that do not lie within the desired region. For this question you may approximate the shape of the cell as a circle whose area is equal to the area of the (hexagonal) cell (radius about 0.91 of the distance from the cell center to a vertex of the bounding hexagon).
   - You may use any programming language. If you use Matlab you may find it useful to represent coordinates as complex numbers and to use the sort function.

2. Consider the quadrature down-converter shown below:



   The RF input signal is $cos(\omega_c t + \phi)$, and the two LO signals are $cos(\omega_c t) + k$ and $sin(\omega_c t) + k$, where k is a constant DC-offset value. Derive the equation of the signals at the two mixer outputs in terms of the sinusoidal signal components. What are the requirements for the low-pass filters in order to recover the only the quadrature (phase) value?

3. Answer the question below (taken from the text *Wireless Communications* by Rappaport (first edition)).

Assume each user of a single base station mobile radio system averages three calls per hour, each call lasting an average of 5 minutes.

(a) What is the traffic intensity for each user?

(b) Find the number of users that could use the system with 1% blocking if only one channel is available.

(c) Find the number of users that could use the system with 1% blocking if five trunked channels are available.

(d) If the number of users you found in (c) is suddenly doubled, what is the new blocking probability of the five channel trunked mobile radio system?